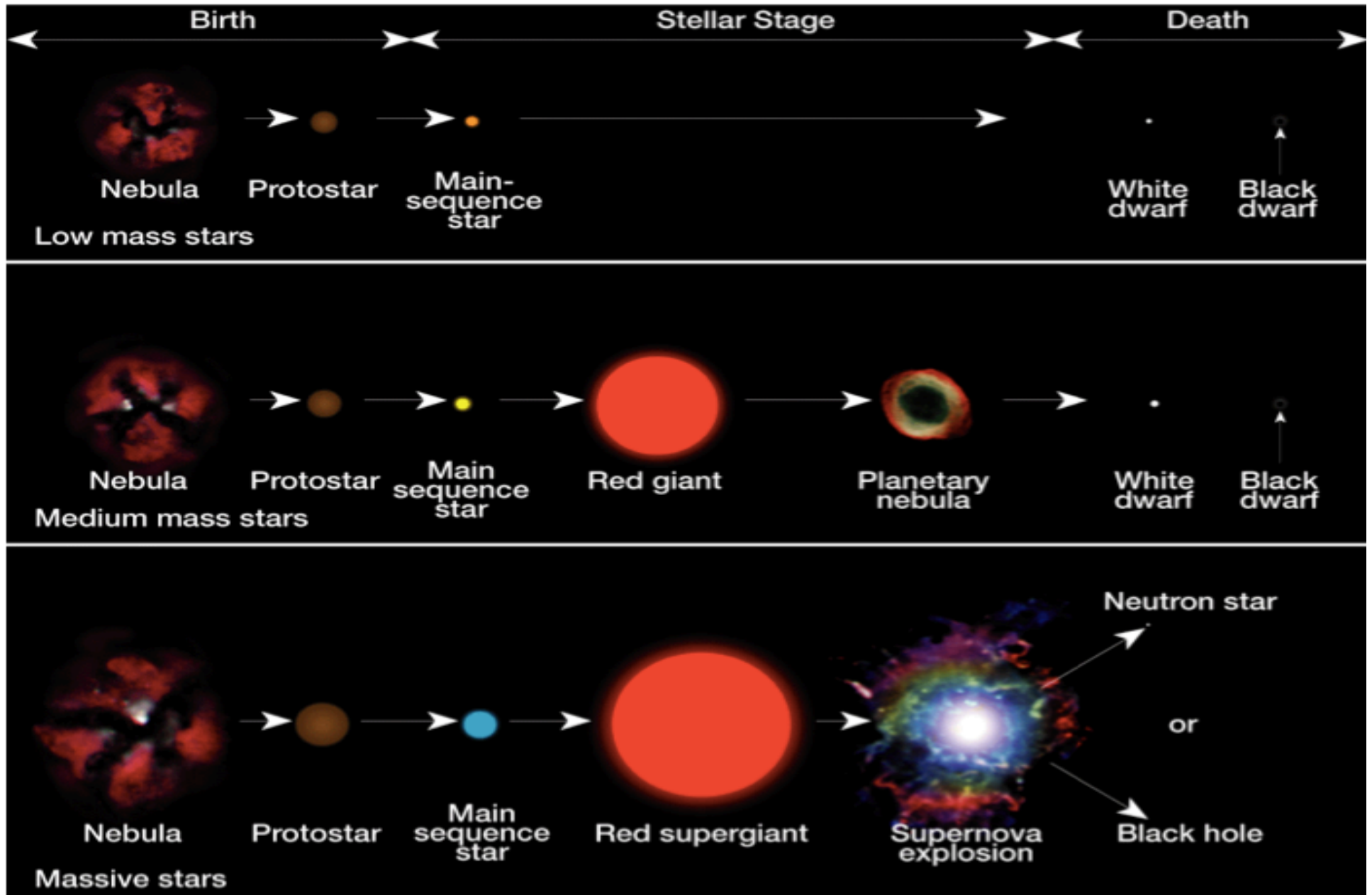


Station 1: Life Cycle of a Star






What To Do At This Station?

You are responsible for:

- Drawing an image and labeling each box from the star life cycle image
- Include a caption/notes for each box (a characteristic or fact)
 - If you'd like to take more detailed notes, please do so on the back of the sheet.

Key for Lifecycle Boxes & Arrows

- Key  = Low Mass Stars
 - Have longer life spans than high mass stars
 - Burn their fuel more slowly
 - Outline all top boxes RED, connect w/RED arrows
- Key  = Medium Mass Stars
 - Outline all middle boxes ORANGE, connect w/ORANGE arrows
- Key  = High Mass Stars
 - Have shorter life spans than low mass stars
 - Burn their fuel more quickly
 - Outline all bottom boxes BLUE, connect w/BUE arrows

Stellar Nebula

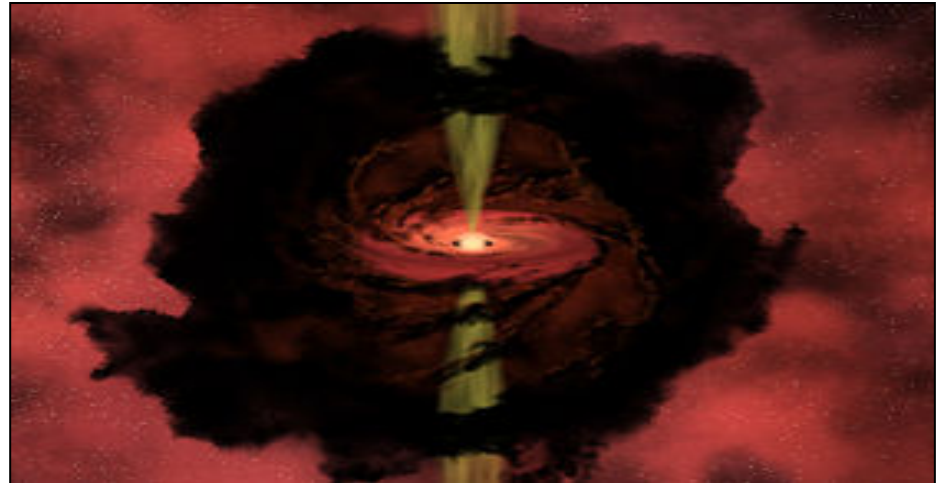
- Birthplace of stars; dark, cool, cloud of dust and gas
 - Nebular theory: creation of solar system
- Cloud condensed by passing stars or supernova explosion
- Stars glow when hydrogen fuel is burned (aka nuclear fusion)
- As stars age, H fused to He, C, Fe & other heavier elements to increase star's density



Protostar

- Initial contraction → 1 million years
 - Temperature increases → long wavelength red light
- Developing star not yet hot enough to engage in nuclear fusion
- When core has reached 10 million Kelvin, pressure initiates nuclear fusion of hydrogen
 - STAR IS BORN!

An artist's rendition of a protostar



Main Sequence Stars

- Remains in this stage until death
- Internal gas pressure struggles with force of gravity
- Fusion continues for a few billion yrs. → provides enough outward pressure to keep star stable
- Stars age @ different rates:
 - Ex: Hot/massive/blue: shorter life cycle
- Longest stage of life cycle (90% of life cycle)

Red Giant/Red Supergiant

- Zone of hydrogen fusion in star continually moves outward → leaving behind a helium core → hydrogen used up
 - Fusion occurring in outer shell but not inner
- Pressure is unbalanced → core contracts (hotter)
 - Heat radiates throughout star and expands → surface cools as size increases (red in color b/c of cool temps. $\sim 3,000\text{-}5,000\text{ K}$)



Death of a Low Mass Star

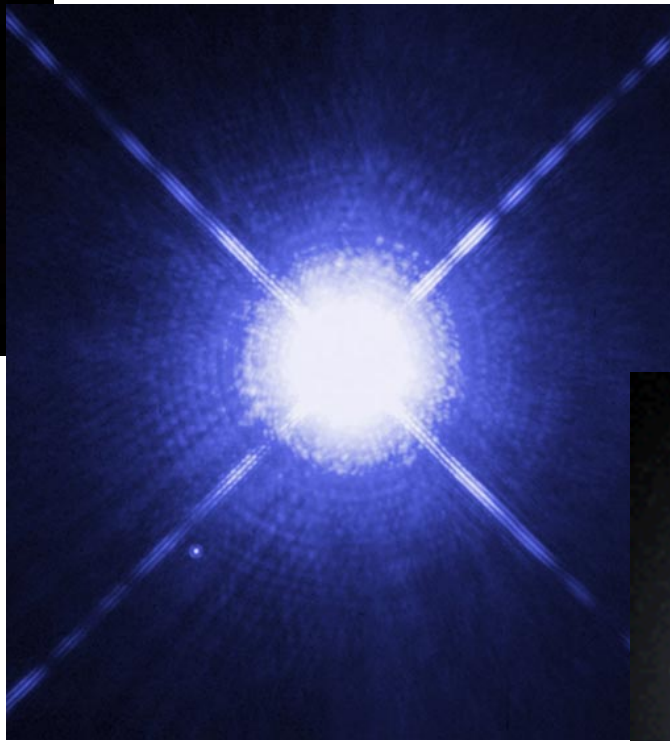
- Stars less than one half the mass of the Sun
- Consume fuel slowly
- Remain on Main Sequence for up to 100 billion yrs.
- Never reaches high enough temps. or pressures to fuse He → never evolve into red giants
- White Dwarf: star collapses; smaller than Earth and extremely dense; extreme surface gravity
- Black Dwarf: white dwarfs continue to cool; no source of energy

Death of a Medium Mass Star

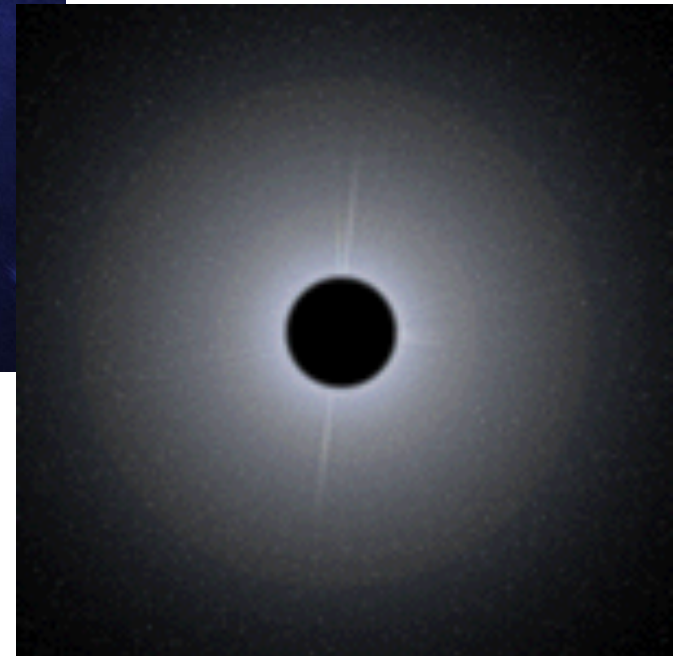
- Planetary Nebula
 - Gas is used up
 - Star condenses & outer atmosphere blows off
- White Dwarf [as dense as the Sun but as big as the Earth]
 - Last of remaining fuel burns
 - Core of heavy elements shrinks in size
- Black Dwarf [is a cooled white dwarf → no longer emits light]
 - No remaining fuel, stops burning
 - Just a core of leftover matter



Planetary Nebula



White Dwarf



Black Dwarf

Death of a High Mass Star

- Supernova
 - Gas used up, triggers violent collapse of RSG
 - Collapse triggers a huge explosion
 - shockwaves can condense distant nebulae=new stars!
- Final fate of star determined by mass of star
 - 4-8 X Sun' s mass: Neutron star—20 km in diameter
 - Equal to a tsp on Earth weighing 1 billion tons!
 - *Label arrow on top branch*
 - +3 X Sun' s mass: Black hole
 - *Label arrow on bottom branch*

The Death of a High Mass Star

- 1.4 X Sun's mass: Neutron star (shell)
 - Dense core can't support self, collapses



➤ +3 X Sun' s mass: Black hole

- Collapse so great all matter (even light!) is pulled in @ speed of light!
- White holes? Spit matter out on “other side”
- Wormholes? Combo of black + white hole...time travel??

